

APPRAISAL REPORT

GARDNER, MASSACHUSETTS

AUGUST 1987

CONNECTICUT RIVER

LOCAL FLOOD PROTECTION



US ARMY CORPS
OF ENGINEERS
NEW ENGLAND DIVISION

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WALTHAM, MASSACHUSETTS 02254-9149

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I. INTRODUCTION

A. AUTHORITY

The construction of the Gardner Local Protection Project (LPP) on Mahoney and Greenwood Brooks in Gardner, Massachusetts, was authorized by the Chief of Engineers on 19 March 1964, pursuant to authority contained in Section 205 of the 1948 Flood Control Act, as amended by the Flood Control Act of 1962.

ER 165-2-119, dated 20 September 1982, provides guidance for the Corps to observe, monitor and document, as appropriate, the adequacy of completed projects, including Local Protection Projects, which were completed under Corps authorization in order to ascertain whether they continue to function in a satisfactory manner and whether potential exists for better serving the public interest.

Development in watershed areas and new information on basin hydrology since the project's construction may warrant an updated analysis of the degree of protection being realized. The objective of this appraisal is to determine whether it is advisable to modify the project due to changes either in the area being protected or to make changes to the project to improve its viability, safety and reliability.

B. PURPOSE AND SCOPE OF APPRAISAL

The purpose of this investigation is to assess the adequacy of the existing local protection project on Mahoney and Greenwood Brooks in South Gardner, Massachusetts, and to determine if modifications are advisable and warrant further Federal study.

The scope of this particular report is of appraisal nature. The objectives are:

- . Compile existing information
- . Initiate public involvement
- . Establish the need or lack thereof for modification

In the case when modifications are necessary:

- . Identify modification opportunities
- . Determine preliminary feasibility of modifications
- . Recommend future course(s) of action

The study process is divided into two phases - reconnaissance and feasibility. In the reconnaissance phase, modifications to the project are screened from the standpoint of economic, environmental and engineering integrity and safety considerations. Items of local cooperation, both past and future, are addressed when an affirmative action is recommended.

If warranted, the feasibility phase would detail the actual modification alternatives and recommend a particular course of action. The recommendation would be based on a comparison of each alternative's expected accomplishments.

C. LOCAL PROTECTION PROJECT AREA AND PURPOSE

The city of Gardner is located in Worcester County, Massachusetts, some 60 miles northwest of Boston and 25 miles north of Worcester. Although the area protected by the Gardner LPP (see Plates 1 to 3) lies in the industrial area of South Gardner, it contains commercial and residential properties as well. The LPP provides protection from overbank flooding for a distance of approximately one and one-half miles downstream from Wrights Reservoir on Greenwood Brook and Wayside Pond on Mahoney Brook to the outlet of Ramsdall Pond. Prior to the construction of the LPP, the major damage areas were primarily along Mahoney Brook. The major features of the LPP are Upper Wrights and Wrights Reservoirs, dams and control structures on Greenwood Brook and Wayside Pond, dam and control structure and Mahoney Pond, dike and spillway along Mahoney Brook and channel improvements along both brooks. Upper Wrights Reservoir and a portion of Wrights Reservoir lie in the town of Westminster. The confluence of the two brooks is downstream from Wrights Reservoir on Greenwood Brook and from Wayside Pond on Mahoney Brook.

D. PUBLIC COORDINATION

The city of Gardner was notified by letter dated 7 January 1987, of the New England Division's (NED) initiation of the study to review the adequacy of the existing LPP in terms of present and future conditions in the area protected and of the advisability of possible modification to the LPP.

On 19 February and 9 April 1987, personnel from NED visited the project and the protected area. Meetings were held with the City Engineer and Director of Community Development and Planning to review the project and to discuss and to obtain their views on the investigation. The latter visit coincided with the aftermath of heavy rains which resulted in the highest recorded water level of Wrights Reservoir on 8 April 1987. The spillway carried about one-half inch of water at flood crest. The City Engineer expressed his satisfaction with the performance of the project during the flood. In the absence of the project, he visualized serious problems near the confluence of Mahoney Brook and Foster Brook where the waters of Foster Brook had begun to back up flow into Mahoney Brook.

E. PRIOR STUDIES

A number of studies relative to flooding conditions in South Gardner and to the design and justification of the Gardner Local Protection Project have been undertaken.

- Corps of Engineers, Gardner Local Protection Detailed Project Report, November 1962, which outlined the project's feasibility.
- Corps of Engineers, Operation and Maintenance Manual for Flood Protection Works, Gardner, Massachusetts, March 1966, prepared upon completion of the project for use by local interests.
- Federal Emergency Management Agency, Flood Insurance Study - City of Gardner, Massachusetts, January 1981.
- Semi-annual inspection reports prepared by the Operations Division of the New England Division, Corps of Engineers. The most recent inspection undertaken on 7 October 1986 is discussed below under Recent Inspections.

II. EXISTING CONDITIONS

A. PROJECT HISTORY AND DESCRIPTION

1. Construction

The existing Gardner LPP was constructed in 1964 and 1965. It provides flood protection from overbank flooding to properties downstream from both Wrights Reservoir on Greenwood Brook and Wayside Pond as far as the outlet to Ramsdall Pond on Mahoney Brook. In addition, Wrights Reservoir is operated at higher levels for waterfowl habitat and for recreation and land enhancement purposes. The cost of construction in 1965 was estimated at \$511,000, including \$15,500 for items of local cooperation. By comparison, the cost of construction in 1987 dollars would be approximately \$2,045,000 based on an update using a combination of the Engineering News-Record's Construction Cost Index and the Implicit Price Deflator.

The project provided for the construction or reconstruction of dams and dikes, all of compacted earth with and without gravel fill construction, concrete spillways and channel improvements, primarily to increase flood control storage and to increase the capacity of Mahoney Brook and to prevent the flooding of adjacent properties. Essentially the project features (Plates 2 to 10) are:

Wright's Reservoir: The new dam is located on Greenwood Brook at High Street and consists essentially of the reconstruction of a dam, with a concrete spillway and gated outlet. Works include four earth dikes: 630 feet and 305 feet on either side of a 60-foot spillway (crest 1,070 feet NGVD), a 160-foot long dike along the spillway discharge channel and a 970-foot flanking dike (1076 feet NGVD) on the west side of the reservoir which prevents the diversion of flow into Baker Brook and Ramsdall Pond. A 3-foot by 10-foot box weir with a rim elevation of 1065 feet NGVD maintains normal water level and a 27-inch pipe carries flows from the weir, through the spillway into the outlet channel. Since 1972, the Corps authorized a maximum water level of the reservoir of 1066 feet NGVD from 16 September through 14 May and 1067 feet NGVD from 15 May to 15 September for recreational and land enhancement purposes.

Upper Wrights Reservoir (Whitney Street Control Structure): Partial reconstruction of dike between Upper Wrights Reservoir and Wrights Reservoir and the placement of additional pipe culvert capacity, that is, two bituminous coated corrugated metal pipe arches 72 inches and 44 inches with a lip elevation of 1073 feet NGVD. This project feature is located in Westminister, Massachusetts. The pipe arches supplement the existing pipes under the causeway between the two dams in order to carry flood flows from Upper Wrights to Wrights Reservoir.

Wayside Pond: Construction of a 320-foot long dam with three bituminous coated corrugated metal pipe arches 72-inch by 44-inch providing for a spillway capacity of 510 cfs. The dam was constructed to 1073 feet NGVD. Two of the pipes have flared sections with lip elevations of 1066. The third pipe has a concrete box inlet with stoplogs to permit lowering of the pond when necessary.

Mahoney Pond to Chelsea Street: Improvements at this location provided for the construction of a concrete spillway, two earth dikes, channel excavation and realignment over a length of approximately 685 feet. The 45-foot wide spillway has a crest elevation of 1050 feet NGVD. The adjacent 360-foot long dike at Mahoney Pond has a top elevation of 1055 feet NGVD. A second downstream dike, 270 feet in length, channelizes flow and prevents flooding of adjacent buildings.

Other Channel Improvements: Other channel improvements included the removal of several channel obstructions (on old gate structure, a partially destroyed dam, dumped material, etc.) and the construction of bin type retaining walls where Mahoney Brook passes under South Main Street.

2. Modifications

(a) In 1972, the city of Gardner requested and received authorization to raise the water levels at Wrights Reservoir. According to the Detailed Project Report (November 1962), the normal water level was designed to be maintained at elevation 1065 feet NGVD. Permission was subsequently granted to raise the water level to 1066 feet from 16 September through 14 May each year for aesthetic and recreation purposes. The provision for the maintenance of the pool at 1067 feet between 15 May and 15 September had been included earlier in the Operation and Maintenance Manual (March 1966).

(b) Adolph Jandris and Sons, Inc., placed twin 60-inch diameter culverts along Greenwood Brook between the outlet to Wrights Reservoir and East Broadway in September 1980. Since that time, the company has extended buildings over the culverts. Cease and Desist Orders were issued by the city's Conservation Commission and representatives of the Corps of Engineers. The culverts appear to be adequate to carry the Standard Project Flood (SPF) reservoir outflow of 335 cfs from Wrights Reservoir. However, in a letter from the Corps Regulatory Branch to the Gardner Conservation Commission, it was determined that an individual Corps permit had been required but not obtained for the work.

(c) Several fences have been constructed on the two main dikes at Wrights Reservoir by the same party who installed the twin 60-inch culverts above.

(d) During 1985-86, triple 60-inch diameter culverts were installed along Mahoney Brook to provide for a road access to Heritage Village, a mobile home park which was under construction in May 1987. The LPP design flow of this location is 700 cfs. A permit was issued by the Corps for the work on 27 February 1985.

3. Damages Prevented

The method of which damages prevented (benefits) are computed is to compare actual observed flows with those that would have naturally occurred if the LPP had not been in place. The most recent flooding event, in April 1987,

registered a peak stage elevation of approximately 1,022 feet NGVD on the flood gauge which is located 98 feet downstream of the South Main Street Bridge. Total flood damages without an established LPP in Gardner would have totaled approximately \$464,000 primarily in industrial and commercial losses.

4. Level of Protection

Since a large part of the damages experienced in 1936 and 1938 were attributed to dam failures, the strengthening, reconstruction and construction of dam components of the Gardner LPP were designed to pass the Standard Project Flood (SPF) or a flood equivalent to that of 1938, an approximately 200-year recurrence event, without overtopping. In the case of the spillway (elevation 1070 feet NGVD) for Wrights Dam, the SPF design permits passing the design flood resulting in a maximum spillway surcharge of 1.2 feet or an elevation of 1071.2 feet. However, the elevation of the dikes was set at 1076 feet NGVD by routing the Probable Maximum Flood (PMF) over the spillway resulting in a surcharge of 5 feet to which was added one-foot of freeboard. The spillway at elevation of 1070 feet NGVD affords 850 acre-feet of flood control storage, or 5.1 inches of runoff from the 3.2-square mile watershed area under control.

For other components of the LPP the level of protection is less than the SPF because of economic considerations. Most notably the excessive cost of providing new bridges on Mahoney Brook at South Main Street and the Boston and Maine Railroad and additional protection in the vicinity of the Chelsea Street Bridge precluded the provision of channel capacity to eliminate all damages during the SPF. See Current Planning and Design Criteria below for a discussion of the level of protection based on current freeboard requirements.

5. Recent Inspections

The most recent inspection of the Gardner LPP was conducted by the Corps Operations Division on 7 October 1986. According to the subsequent letter sent to the Mayor, the project was found to be in poor condition. The letter also referred to a previous inspection in May 1986 in which some progress had been made in correcting previous deficiencies. However, very little maintenance work had been done in the interim. In addition, the team which conducted the current appraisal viewed the LPP on 9 April 1987. These two inspections indicated the following shortcomings:

(a) The center and right (north) culverts at Wayside Pond dike are undermined and the culvert roofs have been beat downwards and, therefore, the openings have been significantly reduced by damage.

(b) Significant erosion at the east end of the principal dikes at Wrights Reservoir, as a result of uncontrolled off-road vehicle traffic on the dike. Corral fences have also been installed on the dikes which inhibit required maintenance.

(c) The apparent lack of easements to the dike areas on Wrights Reservoir for maintenance (access). Reference was made to an Operations Division letter to the former Mayor, Mr. C. Kean, dated 28 August 1986, indicating

that a review of the Corps real estate files revealed that part of the flood control dike may have been constructed on private property without any real estate interest being acquired by the city.

(d) Excessive brush growth along Mahoney and Greenwood Brooks and on the principal dikes at Wrights Reservoir.

(e) Some accumulation of debris in the channels of Mahoney and Greenwood Brooks, but the amount of siltation and sedimentation has been greatly reduced by the city of Gardner's maintenance.

B. AREA PROTECTED BY THE PROJECT

1. Description of Project Functions

The Gardner LPP was designed and constructed primarily to reduce overbank flooding in the industrial area in South Gardner, Massachusetts, due to heavy rains or a combination of heavy rains and melting snow. The major function of the Gardner LPP is the reduction of flooding in South Gardner. The reduction of flood stages has been accomplished primarily by the provision of storage capacity for Greenwood Brook at Wrights Reservoir. Increased channel capacity is provided along Mahoney Brook. Dikes at Wrights Reservoir, Mahoney Pond and along Mahoney Brook contain water within the holding areas, channelize flow or prevent flooding of property. The project also includes water control structures at Upper Wrights Reservoir, Wrights Reservoir, Wayside Pond and Mahoney Pond.

However, the project does include multi-purpose features. The original conception of the project included the maintenance of former pool levels at Wayside Pond for waterfowl habitat. The level of this pool has not been an issue since the construction of the LPP. The Operation and Maintenance Manual for the Gardner LPP sets a higher level of Wrights Reservoir during the summer months for recreation, as well as for the enhancement of aesthetics. Subsequent correspondence between the Corps and the city set the maximum levels at 1,066 feet between 16 September and 14 May and 1,067 feet between 15 May and 15 September each year. Recreation features such as fishermen access were specifically excluded from Wrights Reservoir at the time of the design and construction because it was not considered particularly attractive for public use due to poor access and to the absence of publicly owned land.

2. Land Use and Changes

The record flood of 1938 caused flood damage losses to 40 residences, 11 industrial firms, 9 commercial establishments and to four roads in South Gardner. The industrial firms located along Mahoney Brook suffered the heaviest losses. In 1961, it was noted that several business establishments and residences had been built in the study area thereby increasing potential flood losses.

A field inspection in April 1987 indicated that, with a few exceptions, land use has changed little since the completion of the Gardner LPP in 1965. However, the South Gardner project area has undergone specific changes in

industrial and commercial activities such as the substitution of lighter industrial enterprises or a decrease in activity for some firms as compared to 1961. These changes reflect a State and nation-wide decline in traditional manufacturing and a transition to lighter manufacturing.

Albert C. Jandris and Sons, Inc., has enclosed Greenwood Brook between Wrights Reservoir and East Broadway in a twin 60-inch concrete culvert. A building has also been extended over the culvert. Heritage Village is under construction north of Mahoney Brook and west of Partridge Street for some 90 mobile homes. The Denny Manufacturing Company is expected to be converted from industrial to residential use. These changes do not have a significant effect on the hydrology of the project area, but indicate the changes in land use that have occurred.

3. Hydrology and Hydraulics

a. Flood Discharges

The greatest flood known in Gardner occurred prior to project construction in September 1938, as a result of hurricane associated rainfall totalling over 14 inches. The second greatest flood occurred in March 1936 as a result of about 4.6 inches of rainfall with high antecedent snowmelt conditions. Since construction of the project, several moderate flood events have occurred for which the project reportedly functioned effectively. Flood events, in the range of 5 to 15-year recurrence intervals, occurred in March 1968, December 1973 and January 1979. The most recent event occurred in March-April 1987 when, as a result of twin storm rainfall totalling about 10 inches (31 March-8 April), the 5.1 inches of flood storage at Wrights Reservoir was completely filled. However, this storm did not achieve the 1.2 feet of spillway surcharge associated with the SPF and was, therefore, less than a SPF event.

As previously stated, project features were designed for the SPF and provide SPF protection except at locations where existing structures or developments precluded channel modifications. The following is a listing of SPF, September 1938 and one percent annual chance (100-year) discharges as estimated for purposes of project design. Developed profiles are shown on Plate 4.

TABLE 1
Gardner Local Protection Project
FLOOD DISCHARGES (cfs)

	<u>Below Greenwood Brook</u>	<u>Below Foster Brook</u>
<u>Experienced:</u>		
1938	700	1,100
<u>Modified by LPP:</u>		
Standard Project Flood	700	1,500
1938 Flood	360	760
One percent (100-year) event	375	725

b. Flood Profiles

During the design of the project, modified profiles were computed using standard step backwater procedures.

In August 1974, 9 years after project completion, an inspection and survey by Corps personnel revealed that:

- (1) Several stretches of the channel had up to a foot of sand and silt accumulation.
- (2) One of the two 5-foot wide culverts under West Broadway was nearly filled with gravel and the two 5-foot culverts under Partridge Street were laden with about 1-foot of sand and gravel.
- (3) Accumulation of debris and vegetative growth in and adjacent to the streambed was reducing the discharge capacity of the stream.

In the 1974 review conducted by the Corps' Water Control Branch, profiles were checked using the HEC-2 computer backwater program. This review confirmed the original design profiles but indicated a slightly higher flood profile on Mahoney Brook due to severe channel silting and sedimentation. The city of Gardner has since taken action in clearing the channel and removing the obstructions at the hydraulic controls. The water surface profile for the channel as originally developed is shown on Plate 4.

III. FUTURE CONDITIONS

A. LAND USE

1. Community Plans

A master plan for Gardner is being undertaken but not yet completed at this time. Zoning changes currently under consideration for the city are not expected to affect future land use significantly in South Gardner, the site of the LPP.

A discussion with the City Engineer indicated that most of the current and future development will be concentrated on land north and east of the areas protected by the LPP. The City Engineer provided the Corps with a comprehensive list of all the residential construction underway or planned for 1987-1988. If all the planned construction is completed, a total of 2,500 new residential units will be created. Little of this development is projected in the catchment basin upstream of the Gardner LPP.

2. Potential Flood Losses

There has not been a detailed review of changes in land use in the city of Gardner since the original damage survey was completed in 1961. As mentioned earlier, in Land Use and Changes, a site visit in April 1987 revealed that there had been little change in land use within the project area since the construction of the project. No significant land use changes are planned in the project area. Although there has been some residential development in the Greenwood and Mahoney Brooks watersheds, as well as elsewhere in the city, it is not expected that these developments will significantly contribute to runoff and, therefore, to the worsening of the potential for increased flooding in the project area for the immediate future. However, according to the City Engineer, an area of concern could be backwater along Mahoney Brook at its confluence with Foster Branch at the downstream end of the LPP.

A recurrence of the 1938 flood, an approximately 200-year event, under land use conditions that existed in 1961 in South Gardner would have caused flood losses of \$1,280,000 in 1962 prices. Adjusted to the 1987 price level, these losses would be equivalent to \$5,620,000 as indicated in Table 2 below.

TABLE 2
GARDNER LOCAL PROTECTION PROJECT
POTENTIAL FLOOD LOSSES - RECURRENCE OF 1938 FLOOD OF RECORD
WITHOUT THE GARDNER LPP IN PLACE

<u>LAND USE CATEGORIES</u>	<u>FLOOD LOSSES - 1961</u>	<u>PERCENT OF</u>
	<u>CONDITIONS & 1987</u> <u>PRICE LEVEL</u>	
Residential	\$ 136,000	2
Commercial	753,000	13
Industrial	4,582,000	82
Highway	149,000	3
TOTAL	\$5,620,000	100

B. PROJECT INTEGRITY

Since its completion in 1967, the Gardner LPP has performed its function to reduce flood losses in South Gardner. For example, during the most recent flood event in April 1987, it is estimated that the Gardner LPP prevented approximately \$464,000 in losses. However, recent inspections have identified a number of deficiencies that should be addressed in order to ensure the project's intended performance. These deficiencies are highlighted earlier in Recent Inspections.

IV. CURRENT DESIGN CRITERIA

Since a large part of the damages experienced by the 1936 and 1938 floods in South Gardner were due to dam failures, the dam components for the Gardner LPP were generally designed to pass the Standard Project Flood, an approximately 200-year recurrence event. In this case, the Wrights spillway surcharge would be 1.2 feet. However, the elevation of the dikes were set on the basis of the Probable Maximum Flood (PMF) and one-foot of freeboard. The routing of the PMF over the spillway results in 5 feet of surcharge to which one-foot of freeboard was added to obtain the elevation of the top of the dam of 1076 feet NGVD. The design criteria for the other components of the LPP were largely influenced by existing structures, the modification or replacement of which would be economically prohibitive. The degree of protection provided by channel improvements is also generally less than the Standard Project Flood. Land use in and adjacent to the project area has undergone little change since the completion of the Gardner LPP. This situation is projected to continue into the future. There is no reason to modify the criteria associated with the level of protection for the Gardner LPP at this time.

However, current engineering regulations call for freeboard allowances above the design elevation of 2 feet for concrete walls and 3 feet for dike or levee systems. Using the criterion of 3 feet of freeboard, the level of protection afforded by Wrights Reservoir at an elevation of 1073 feet NGVD (1076 less 3 feet) is more than the Standard Project Flood.

The flood damage prevention benefits for the economic analysis for the Gardner LPP were computed for all floods having a frequency less than or equal to the SPF whose probability of recurrence is once in approximately 200 years. In other words, no benefits were included for floods having a frequency of recurrence more rare than 200 years.

Current planning guidance allows for taking credit for expected benefits within the bottom half of the freeboard range. The application of this criterion to the Gardner LPP translates into an elevation of 1074.5 feet NGVD (1076.0 less 1.5 feet) up to which benefits could be taken.

The use of current guidance with respect to freeboard requirements and to the methodology for calculating benefits for the Gardner LPP would result in a higher range over which benefits could be calculated, ie. currently up to an elevation of 1074.5 feet NGVD as compared to 1071.2 feet NGVD when the original calculations were done in 1962. The benefit cost ratio at that time was a healthy 1.5. It is likely, therefore, that the economic feasibility of the project would be improved if current freeboard requirements and guidance for calculating benefits were applied to the project in 1962.

V. OUTSTANDING ISSUES

A number of issues relative to the Gardner Local Protection Project are outstanding.

A. Project Deficiencies

Several deficiencies in the LPP were identified in the most recent inspection report by the Corps of Engineers, dated 7 October 1986 (see Enclosure 1) and Members of the team that conducted this appraisal:

- (1) The center and right (north) culverts at Wayside Pond are undermined and the culvert roofs have been bent downwards thereby reducing the culvert openings and capacity;
- (2) Significant erosion of the east end of the principal dikes at Wrights Reservoir, and
- (3) Excessive brush growth along and debris deposits in Mahoney and Greenwood Brooks and brush growth and illegal fences on the principal dikes at Wrights Reservoir.

B. Lack of Easements

In a letter dated 28 August 1986 to the Mayor of Gardner, the Corps' Operations Division indicated that a review of the Corps' real estate files revealed that part of the principal dike at Wrights Reservoir may have been constructed on private property without any real estate interest being acquired by the city. The city was requested to correct the deficiency immediately in accordance with the provisions of the Assurances signed by the city on 20 May 1964. No apparent progress in this respect has been made to date.

C. Floodway Encroachment

The city of Gardner signed an Assurance for the LPP on 20 May 1964 which indicated the city's willingness to execute the provisions of the agreement. Paragraph (h) of the Assurance commits the city to "establish ordinances to prevent further encroachment in the natural flood plain of the Mahoney and Greenwood Brooks in these areas where easement takings are not required for construction of project features. The ordinances will provide for a floodway defined as the area within 25 feet of the centerline of the brooks in which no new construction of any type will be permitted and existing hazardous structures will be removed when obsolete."

Ordinances for the city of Gardner, covering the period 1923 through 20 September 1972, include the provision of Flood Plain Districts where land use conditions are to be maintained. Although the water courses for the Gardner LPP are generally protected by the provisions of the Flood Plain Districts,

the portion of Greenwood Brook from High Street to East Broadway has been excluded from the regulations in violation of the Assurance since, according to the ordinance, it was "enclosed or to be enclosed by a culvert pipe of adequate size."¹ It is in this excluded area that Mr. Jandris has installed twin culverts and extended his building (see Enclosure 2).

Twin 60-inch diameter culverts were placed on Greenwood Brook between Wrights Reservoir and East Broadway in September 1980. Since that time the company, Adolph Jandris and Sons, has extended buildings over the brook. Mr. Jandris contends that the works have been constructed on his property. In a letter from the Corps Regulatory Branch to the Gardner Conservation Commission, it was determined that an individual Corps permit had been required but not obtained for the works.

D. National Flood Insurance Program (NFIP)

A Flood Insurance Study was completed by the Federal Emergency Management Agency on January 2, 1981 for the city of Gardner, Massachusetts. The city, through a referendum, had decided to withdraw from the NFIP prior to its suspension from the program on 2 July 1981.

E. The Level of Wrights Reservoir

Abutters to Wrights Reservoir have petitioned the city of Gardner and the Corps of Engineers over the years to raise the summer level of the reservoir to 1068 feet. Some of the abutters insist that the construction of the LPP has resulted in the lowering of the level of the reservoir compared to its prior level. Present operational procedures authorize maximum levels of 1066 feet NGVD from 16 September through 14 May and 1067 feet NGVD from 15 May through 15 September each year. The Corps has not authorized the raising of the level since the reduced reservoir storage would cause higher downstream riverflow with significant downstream flood damage during periods of heavy rainfall. Proposals have also been made to raise the level of the spillway and other project features by one-foot but these have not been pursued. Another facet of the issue is whether the 4.8-foot freeboard above the SPF could be reduced by raising the elevation of the spillway. Current policy does not allow the Corps to participate in such recreation improvements. These efforts would be entirely at the city's expense, and it is not likely that the city would support such an undertaking at this time. Some residents have also expressed the concerns that their basements may risk flooding if the pool elevation is raised.

F. Elevation Discrepancies

More recently, the City Engineer has raised the issue of discrepancies between elevations established for some of the components of the LPP by the consultants who prepared the Flood Insurance Study for Gardner and those

¹ City of Gardner, Massachusetts, Compilation of Ordinances 1923 Through September 20, 1972, p. 163.

established by the Corps. Unfortunately, the consultants did not fix an elevation for the Wrights Reservoir spillway. However, the Corps shows an elevation of the spillway of Mahoney Pond of 1050.00 feet while the consultants indicate an elevation of 1048.48. The latter elevation was rechecked by the consultants. A possibility exists that Wrights Pond spillway was installed at an elevation lower than the design elevation (see Enclosure 3).

VI. MODIFICATION OPPORTUNITIES

A. LEVEL OF PROTECTION

The Gardner LPP provides SPF (an approximately 200-year recurrence event) protection at the principal flood protection features of the project, Wrights Reservoir, with 4.8 feet of freeboard up to the top of the dikes. The routing of the Probable Maximum Flood (PMF) results in a 5-foot surcharge and one-foot of freeboard. The degree of protection provided by channel improvements is generally less than the SPF. The design criteria for other components of the LPP had been largely influenced by existing structures, the modification or replacement of which would be cost prohibitive. Land use in the project area has changed little since the completion of the LPP in 1965. For these reasons, a higher level of protection for the area protected by the LPP is not warranted at this time.

B. PROTECTED AREA

Inspection of the areas adjacent to and downstream from the area protected by the LPP indicate no significant development since the completion of the LPP. The extension of the protected area is, therefore, not needed at this time.

C. PROJECT FEATURES

Project deficiencies, lack of easements, and the question of encroachments as noted above in Section V, Outstanding Issues, should be corrected in order to comply with the Assurances signed by the city of Gardner on 20 May 1964.

VII. CONCLUSIONS

An increased level of protection or extension of the protected area at the Gardner Local Protection Project is not needed at this time. Except for the deficiencies noted above, the project is in good condition and is expected to perform its intended purpose in the future. The lack of easements and the unauthorized encroachment of the LPP area with the consent of the city, however, should be corrected since these shortcomings may interfere with the city's responsibility to properly maintain the project and with the ability of the project to realize its objectives to protect property and to reduce the risk to life. The possible discrepancies in vertical datum elevation for certain features of the LPP is an outstanding issue.

VIII. RECOMMENDATIONS

Modifications to increase the level and extent of flood protection for the Gardner LPP are not recommended at this time. The corrections of the deficiencies noted above under Section V, Outstanding Issues, should be undertaken. These are: (1) The undermining of the center and right (north) culverts of Wayside Pond, and the reduced openings of these culverts; (2) Erosion of the east end of the principal dikes of Wrights Reservoir; and (3) Excessive brush growth along and debris deposits in Mahoney and Greenwood Brooks and brush growth and illegal fences on the principal dikes at Wrights Reservoir. It is further recommended that the city of Gardner comply with the Assurances signed by the city of Gardner on 20 May 1964, and in particular with respect to the need for easements for all project features and for the prevention of encroachment of the designated project area. Otherwise, a safety risk to the public and to property could ensue.

IX. ENCLOSURES

- 1 - Letter and Inspection Report, November 18, 1986 from Corps Operations Division to Mayor, City of Gardner (seven pages)
- 2 - Excerpt: City of Gardner, Massachusetts Compilation of Ordinances - 1923 through September 30, 1972, page 163 (one page)
- 3 - Correspondence on discrepancies in vertical datums in Gardner LPP area (five pages)

November 18, 1986

Operations Division, Project Operations Branch

Honorable Allan Agnelli
Mayor of the City of Gardner
City Hall
Gardner, Massachusetts 01440

Dear Mayor Agnelli:

An inspection of the Federally built local protection project in Gardner, Massachusetts was conducted by my representatives on October 7, 1986. I have enclosed a detailed inspection report for your review.

The project was found to be in poor condition due to excessive brush growth along Greenwood and Mahoney Brooks and on Wright Reservoir dikes 2 and 3. This vegetative growth combined with the small debris deposits in the channels, seriously threatens the ability of the project to function as designed. The debris should be removed from the channels, the brush should be cut and all rip-rap slopes treated with herbicide.

During our previous inspection in May 1986 we noted that significant progress had been made towards correcting previous deficiencies, however, very little maintenance work was accomplished in the interim. Mr. Kirby informed my personnel that due to Mr. Lepkowski's resignation there has been little continuity in the maintenance of the project. This situation needs to be corrected, specifically, as follows:

1. The center and right (north) culverts of the Wayside Pond Control Structure are undermined. This condition was noted during the May 1983 inspection and it appears that no corrective action has been taken to date. This condition could lead to failure of the Wayside Pond dike during flood impoundment operations.

2. Significant erosion at the east end of Wright's Dike number 2 should be repaired. This erosion appears to be a result of uncontrolled off road vehicle traffic on the dike. This unauthorized vehicle activity should be eliminated.

We are also concerned about the apparent lack of easements to the dike areas on Wright's Reservoir. As indicated in our August 28, 1986 letter to Mr. C. McKean, former Mayor of the City of Gardner, a review of the real estate files revealed that part of the flood control dike structure may have been constructed on private property without any real estate interest being acquired by the City. If this is the situation, this deficiency must be corrected immediately. If you require additional information, feel free to contact me at (617) 647-8411.

I am forwarding a copy of this letter to Mr. Richard Kirby, Municipal Grounds Director, City Hall, Gardner, MA 01440; Mr. Rossir St. Jean, City Council President, City Clerk's Office, City Hall, Gardner, MA 01440; and Mr. Charles F. Kennedy, Director and Chief Engineer, Division of Water Resources, Department of Environmental Management, 100 Cambridge Street, Boston, MA 02202.

Sincerely,

scm
FALORETTI

HELMS

Enclosure
as stated

J. C. Wong
Chief, Project Operations Branch

MANOR
Wong
WONG

LOCAL FLOOD PROTECTION PROJECT INSPECTION REPORT

Project: GARDNER, MASSACHUSETTS

Maintaining Agency: GARDNER MUNICIPAL GROUNDS DEPARTMENT

Type Inspection: ☒ Semi-Annual Staff ☐ 90 Day Interim

River Basin: LOWER CONNECTICUT

Date of Inspection 7 OCTOBER 1986

Feature	Sat	Unsat	Deficiencies
PUMPING STATIONS - STRUCTURES		NOT APPLICABLE	
INTERIOR			
EXTERIOR			
PUMPS - MOTORS - ENGINES		NOT APPLICABLE	
TRIAL OPERATED			
GENERAL CONDITION			
POWER SOURCE			
INSULATION TESTS			
METAL INTAKES/OUTLETS			
GATE VALVES			
GATES - DRAINAGE STRUCTURES			
TRIAL OPERATED			
GENERAL CONDITION	X		
LUBRICATION	X		
DIKES - DAMS			
GENERAL CONDITION		X	See remarks
SLOPES/EROSION		X	See remarks
SAND BOILS/CAVING			
TRESPASSING		X	See remarks
SLOPE PROTECTION	X		
DRAINS			
STOP-LOGS - LOG BOOM		NOT APPLICABLE	
CONDITION OF LOGS			
AVAILABILITY OF LOGS			
HIGHWAY SLOTS			
STORAGE FACILITIES			
CHANNELS - OUTLET WORKS CHANNEL			
BANKS		X	See remarks
OBSTRUCTION CONTROL	X		

Feature	Sat	Unsat	Deficiencies
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CONCRETE STRUCTURES

SURFACE	X		
SETTLEMENT	X		
JOINTS	X		
DRAINS	X		

MISCELLANEOUS

EMERGENCY OPER. PLAN	X		
EMERGENCY EQUIPMENT	X		
SEMI-ANNUAL REPORT		X	


Inspection Party: Richard Kirby, Gardner Municipal Grounds Director
 Gerald W. Bartlett, COE, Tully Lake
 Joseph P. Faloretti, COE, Lower Connecticut River Basin
 Ruth M. Kitowicz, COE, Project Operations Branch, Waltham, MA

Photographs Taken: NONE

Remarks & Additional Comments:
 (Indicate Here Observations, Discussions, Specific Feature Deficiencies, Recommendations and any other pertinent information. Use Continuation Sheet if necessary.)

See attached sheets

X ALL APPLICABLE ITEMS. IF UNSAT INDICATE SPECIFIC DEFICIENCIES. INDICATE IF NOT APPLICABLE.

DATE 10 October 86	INSPECTED BY: TYPED NAME & TITLE Joseph P. Faloretti, Basin Manager, LCRB	SIGNATURE 
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GARDNER, MASSACHUSETTS - LOCAL PROTECTION PROJECT

SEMI-ANNUAL INSPECTION

7 OCTOBER 1986

The following conditions were observed during the inspection:

TRAVERS STREET BRIDGE

1. 2 shoals should be removed from downstream of bridge.
2. Brush and small trees (maple) along rip-rap on both sides of the bridge and at the north abutment of Travers Dam should be removed.

SOUTH MAIN STREET BRIDGE

1. Debris between highway and railroad bridges should be removed from Mahoney Brook.
2. Brush growing along rip-rap and at toe of retaining walls should be removed.

PEARSON BOULEVARD BRIDGE (MAHONEY BROOK CHANNEL IMPROVEMENT AND DIKE)

1. Brush along retaining wall should be removed.
2. Extensive brush growth on rip-rap banks should be removed.

SUMMER STREET BRIDGE

1. Brush along rip-rap should be removed.
2. Large trees on both sides of channel, downstream of bridge will catch debris, trees should be removed.

MAHONEY SPILLWAY, MAHONEY DIKE

1. Brush growing along rip-rap should be removed.
2. Trailer park development west of Mahoney Pond should be monitored.
3. Trailer park access constructed across Mahoney Brook upstream from Mahoney Pond. These culverts should be inspected frequently and kept free of debris.

EAST BROADWAY BRIDGE (NEAR MILLER'S GARAGE)

1. Culverts are free of debris.
2. Brush on banks near bridge abutments should be removed.

PARTRIDGE STREET

1. Mahoney Brook culverts are free of debris.
2. Greenwood Brook culverts are free of debris. Brush along road edge and at abutments should be removed.

WAYSIDE POND - CONTROL STRUCTURE

1. Brush on inlet and outlet rip-rap surfaces should be removed.
2. Center and right (north) culverts are undermined. No significant change noted since the last inspection. This condition was first noted during the 18 May 1983 inspection and has not been corrected. This condition may eventually lead to failure of the Wayside Pond Dike.

WAYSIDE POND DIKE

1. The dike slopes are in good condition and were recently mown.

WRIGHTS RESERVOIR - DIKE NO. 3

1. The City of Gardner has no right of way easement across adjacent private property for maintenance of the dike.
2. The dike needs to be mowed.
3. Excessive tree and brush growth along the water (east) side of the dike should be removed. Brush accumulation is most severe along the south end of the dike.
4. The top of the dike is compacted and eroded due to off-road vehicle traffic. This area should be topsoiled and seeded and measures taken to control unauthorized ORV activity.

WRIGHTS RESERVOIR - DIKE 1 AND 2 - CONTROL STRUCTURE AND SPILLWAY-

1. Fences on dikes 1 and 2 remain. These should be removed.
2. Dikes in need of mowing.
3. Brush and tree growth should be removed.
4. No response received by Real Estate Division on real estate parcels to be acquired by the City of Gardner. Mr. Kirby was not aware of what the City was doing to acquire a permanent easement for the portions of the dikes which are located on private property.
5. There is significant erosion on the east end of dike no. 2 near the west spillway abutment. It appears to be caused by off-road vehicle use of the dike as a "jump". This unauthorized vehicle activity should be eliminated and steps taken to repair the erosion.

GENERAL

1. Mr. Kirby requested that a copy of the Project Operation and Maintenance manual be included with the inspection report.

City Gardner, Massachusetts - Compilation of Ordinances
1923 Through September 30, 1972

6. The areas included in the Flood Plain District are also included in other districts defined in this Ordinance and are described generally as follows:
- A. Beginning at a point approximately 25 feet north of the northerly line of East Broadway at the southeasterly corner of the Wayside Pond Dike, so called; thence running southerly about 25 feet to the northerly line of East Broadway; thence running easterly along the northerly boundary of East Broadway approximately 1400 feet to the Gardner--Westminster Town Line; thence in a northerly direction along said Town Line crossing Mahoney Brook (formerly known as Pew Brook) approximately 1150 feet to a point; thence in a southwesterly direction and in a line running parallel to and 250 feet northerly from the Center Line of Mahoney Brook to a point approximately 500 feet easterly from the northeasterly corner of said Wayside Pond Dike; thence in a southwesterly direction approximately 600 feet to a point 10 feet northerly of the northerly spillway of Wayside Pond at a point in the easterly face of said Wayside Pond Dike; thence along the easterly face of said Wayside Pond Dike to the point of beginning.
 - B. Beginning at the outlet of Wayside Pond along Mahoney Brook to Mahoney Pond, so-called, an area on each side of said Brook 25 feet from the center line thereof.
 - C. Beginning at the spillway of Wrights Reservoir, so-called, along Greenwood Brook, so-called, to Mahoney Brook, an area on each side of said Greenwood Brook 25 feet from the center line thereof, excluding such portion of Greenwood Brook from High Street to East Broadway as enclosed or to be enclosed by a culvert pipe of adequate size.
 - D. The area encompassing Mahoney Pond to the High water mark thereof.
 - E. Beginning at the outlet of Mahoney Pond along Mahoney Brook to Travers Pond, so-called, an area on each side of said Brook 25 feet from the center line thereof.
 - F. The area encompassing Travers Pond to the high water mark thereof.
 - G. The area encompassing Bents Pond to the high water mark thereof.
 - H. Beginning at open section of brook between Bents Pond and Ramsdall Pond, below present building to Ramsdall Pond, an area on each side of said brook 25 feet from the center line thereof.
 - I. The area encompassing Ramsdall Pond to the high water mark thereof.
 - J. Beginning at the outlet of the Brook that flows out of Ramsdall Pond, thence along said Brook to Otter River, an area on each side of said Brook 25 feet from the center line thereof.
 - K. Beginning at the confluence of the said Brook that flows out of Ramsdall Pond and Otter River; thence northerly along the course of said Otter River to the Gardner-Templeton Corner No. 3, an area on each side of said River 25 feet from the banks thereof. Thence continuing along said Otter River and the Gardner-Templeton Town Line to the Gardner-Templeton Corner No. 2 an area 25 feet from the easterly bank of said River.



CITY OF GARDNER
MASSACHUSETTS

SURVEY DEPARTMENT

CHAIR CITY



OF THE WORLD

January 9, 1981

Insurance and Mitigation Division
Federal Emergency Management Agency
15 New Chardon Street
Boston, MA. 02114

Re: FIRM Flood Insurance Rate Map (Proof)

Gentlemen:

On at least two occasions since the publication of the "Proposed Flood Elevation Determinations" in September 1980, I have contacted Robert Tier by telephone to try to resolve an apparent discrepancy in vertical datums between your maps and the U.S. Army Corps of Engineers plans for the "Gardner Local Protection Project." The base (100 years) flood elevation just upstream from the Mahoney Brook Spillway is shown as 1051 on your Panel 9 of 9. The corps of Engineers record plans show this spillway elevation to be 1050, while your profile shows it to be about 1048.5. Thus, there appears to be a discrepancy of 1.5 feet between the "National Geodetic Vertical Datum of 1929" used in your studies and the Corps of Engineers "Mean Sea Level Datum" of the early 1960's.

This apparent inconsistency might be easily resolved if your maps indicated a RM (reference mark) somewhere near one of the flood control project structures. However, the nearest RM is about 4500 feet distant from and 50 feet in elevation lower than the Mahoney Brook Spillway.



**CITY OF GARDNER
MASSACHUSETTS**

SURVEY DEPARTMENT



-2-

Following are some elevations which I have taken from the COE Local Protection Project Record Plans and the FEMA Flood Insurance.

LOCATION	ELEVATION ABOVE MEAN SEA LEVEL	
	COE RECORD PLANS	FIRM Study & Map
Just upstream Travers St. Conc. Weir	1012.0	1012.0
Covered Bridge @ Old Quality Pad Site (Conc. Weir)	1025.0	1024.3
Mahoney Pond Spillway	1050.0	1048.5
Wayside Pond Outlet	1069.0	1066.7
		(10 year flood elevation)
Dirt Road over Culverts @ Wayside Pond Outlet	1073.+	1070.5

If such variations occur in one area of the City, why should we accept the validity of these maps throughout our City?

Also, to date I have had no success in getting errors on the base map corrected. Therefore, I am enclosing a set of the "proof" copy of the FIRM Flood Insurance Rate Map with these corrections marked in red.

Sincerely yours,

Arthur E. Young
Arthur E. Young, PE
City Engineer



FEDERAL EMERGENCY MANAGEMENT AGENCY

John W. McCormack Post Office and Courthouse
Boston, Massachusetts 02109

Rec'd from
A.E. Young
9 April 87

26 FEB 1981

Mr. Arthur E. Young, P.E.
City Engineer
City Hall
Gardner, MA 01440

Dear Mr. Young:

This letter is in response to your January 9, 1981, letter to our Insurance and Mitigation Division concerning the proof Flood Insurance Study of the City of Gardner, Massachusetts. This letter also confirms information provided to you by our engineer, Kevin Merli, in a recent telephone conversation.

In response to your first concern regarding a discrepancy in elevations between the U.S. Army Corps of Engineers plans of the "Gardner Local Protection Project" our study contractor, Anderson-Nichols, recently performed a field survey and concluded that the elevations used in the study were accurate. A report of their findings is provided in their February 13, 1981, letter to this office (copy attached).

Five reference marks will be added to the Flood Insurance Study in the vicinity of Mahoney Brook. All your suggested changes to the base map have been submitted to the review contractor in order to revise the proof maps. You should receive a set of the revised proof maps within the next few weeks. In the meantime the maps will be processed for final printing and distribution prior to the July 2, 1981, effective date.

If you have any questions concerning this information please contact Kevin Merli at 223-2616.

Sincerely yours,



Albert A. Gammal
Acting Regional Director

Attachment

Tom

Anderson-Nichols

150 Causeway Street
Boston, Massachusetts 02114
(617) 742-3400

Jerome Degen
Senior Vice President

13 February 1981

Mr. Edward A. Thomas, Director
Insurance & Mitigation Division
Federal Emergency Management Agency
J.W. McCormack PO & Courthouse Bldg.
Room 462
Boston, MA 02109

SUBJECT: Re-examination of Data Base to
Resolve Discrepancies Perceived
to Exist in the Gardner, MA
Flood Insurance Study
Our Job No. 2870-05

Dear Mr. Thomas:

We have, in accordance with your letter of 6 February 1981 with City Engineer Young's 9 January 1981 letter attached, completed our investigations and are pleased to submit our report of findings.

On Tuesday, 11 February 1981, two A-N staff members visited the project area to perform a visual reconnaissance and instrument survey of the points questioned by Mr. Young. Their findings are as follows:

- o At the Covered Bridge at Old Quality Pad Site, there is no evidence of a concrete weir and the irregularly shaped channel bottom has a thalweg at 1024.3 ft. NGVD. There was some evidence that a control gate of some type may have existed in the past but had been removed.
- o At Mahoney Pond Spillway, the crest elevation is 1048.48 ft. NGVD (within 0.02' of elevation used in FIS).
- o At Wayside Pond Outlet, the surveyed elevation of the dirt road was determined to be 1070.22 ft. NGVD (within 0.12' of A-N's previously used elevation of 1070.1, not 1070.5 in Mr. Young's letter). We surmise that the difference between A-N and Corps' elevations may possibly be attributed to road improvements occurring in the interim.

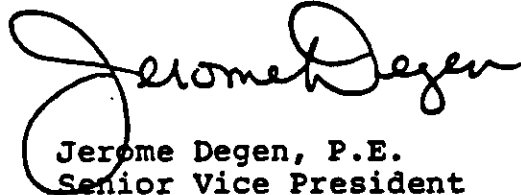
Mr. Edward A. Thomas, Director
Insurance & Mitigation Division
FEMA, Boston, MA

The foregoing elevations were predicated upon closed loop level lines from BM2X (elev. 1062.41). Whereas our re-examination closely verifies the data base elevations provided and certified by a duly licensed survey subcontractor in accordance with detailed performance specifications, we find the data base and the analyses based thereon to be representative of field conditions and meeting the FIA Guidelines and Specifications for Flood Insurance Studies.

We further wish to note that A-N has previously furnished the TEC a listing of the required Elevation Reference Marks for inclusion on the Maps. Insofar as the City has furnished the TEC with a City Map with the current street names, we trust the resolution of this problem has already been effected by the City and the TEC.

Very truly yours,

ANDERSON-NICHOLS & COMPANY, INC.



Jerome Degen, P.E.
Senior Vice President

JD:cr